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ABSTRACT

Scientific work experience programs are those in which teachers work in business, industry, or academic settings and perform scientifically-related work. The presenters in this panel presentation describe the scientific work experience programs they are working with. One purpose of the presentations was describing the practical aspects of the structures and outcomes of these programs to provide a basic understanding for teacher inservice education. The six programs highlighted serve 7th-12th grade teachers, and one program serves K-12 teachers. The programs include a variety of internship experiences. One program has a scientific research orientation, another offers both project and research internships, another is affiliated with a major corporation and integrates the internship with a masters program, and yet another has interpreted industry's quality management strategies into science and mathematics classroom applications. (PR)

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Scientific Work Experience Programs: University and Corporate Collaboratives

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Scientific Work Experience Programs:
University and Corporate Collaboratives

Introduction

The following presentations were delivered by a panel of directors of scientific work experience programs as part of the proceedings of the annual conference of the Association for the Education of Teachers in Science (AETS) held in Charleston, South Carolina on January 28-31, 1993. Scientific work experience programs are those in which teachers work in business, industry, or academic settings and perform scientifically-related work. These work experiences are usually referred to as internships.

The presenters were: Sandy Gottfried from the University of Missouri-St. Louis and Project Director of the Science Teachers as Research Scientists (STARS) program; Carole Kubota from the University of Washington and Director of Programs for the Ford Fellows Science/Mathematics Project; Marie Earle of the Lawrence Hall of Science at the University of California, Berkeley and Executive Director of the Industry Initiatives for Science and Math Education (IISME); and Mary Ann Sheline of Grand Valley State university and Co-director of the RET-E^3 program. Roger Olstad of the University of Washington and Project Director of the Ford Fellows Science/Mathematics Project served as moderator of the panel presentations and the discussion that followed.

After the moderator provided a brief overview of scientific work experience programs in general, the presenters described thematic variations in their collaboratives. The presentations

had two purposes. One purpose was to describe the practical aspects of the structures and outcomes of these programs to provide a basic understanding of the scientific work experience program model for teacher inservice education. A second purpose was to show ways in which this model is translated into practice.

The programs highlighted in this panel presentation/ discussion serve 7th-12th grade teachers, and one program serves K-12 teachers. The programs include a variety of internship experiences. One program has a scientific research orientation, another offers both project and research internships, another is affiliated with a major corporation and integrates the internship with a masters program, and yet another has interpreted industry's quality management strategies into science and mathematics classroom applications. The moderator provided a short comparative summary at the conclusion of the presentations, prior to the discussion.

The St. Louis Research Internship Programs

Type of Program and Grade Levels Served

The St. Louis Research Internship Programs are, as the name suggests, strictly research internships. Four philosophically and structurally similar programs make up the internships. The STARS program, mentioned above, is one of these programs.

The interns are primarily 7-12 grade science teachers. (Occasionally mathematics, computer science, or industrial

technology teachers participate.) Approximately fifteen teachers participate each year.

History

The first of the St. Louis Research Internship Programs was conceived in 1987 with the first summer interns working in 1988. This program provided internships for teachers at the McDonnell Douglas Corporation and was initiated by the Mathematics and Science Education Center (MSEC), a nonprofit professional development organization for mathematics and science teachers serving the St. Louis area. The MSEC is housed on the University of Missouri-St. Louis campus. The McDonnell Douglas Foundation and the McDonnell Douglas Corporation currently funds this eight-week program for five teachers at the McDonnell Douglas Corporation. The MSEC has since developed two additional programs that provide internships at other sites in the St. Louis area. The American Association of Immunologists (AAI) funds a five-week program for four teachers at the Washington University and St. Louis University medical schools. This program began in 1990. In addition, the U.S. Food and Drug Administration (FDA) funds an eight-week program for two teachers at the FDA in St. Louis. This program began in 1992.

The fourth program making up the St. Louis research internship programs is the Science Teachers as Research Scientists (STARS) program, initiated at the University of Missouri-St. Louis in 1989. The first summer interns began in

1990. The Missouri Coordinating Board for Higher Education funds this six-week program for five teachers at UMSL. The National Science Foundation funded a portion of this program in 1990 and 1991. Civic Progress of St. Louis, a philanthropic organization composed of the CEO's of 24 major corporations and institutions in St. Louis, provides funding across programs, giving each teacher intern $200 for curriculum development materials or classroom laboratory supplies.

Goals

The St. Louis research internship programs have three integral components: an internship experience, a curriculum project, and professional leadership opportunities. The goals of the programs are to: (a) provide teachers with experiences in science, mathematics, and technology in an industrial/university research environment; (b) offer opportunities for teachers to interact with professionals from industry and academia in the fields of science, mathematics and technology; (c) assist teachers in translating what they learn during internship experiences into curriculum materials for use in the classroom; (d) encourage teachers to integrate a science-technology-society perspective with their math and science curricula; (e) reinforce the advantages of viewing curriculum development as an ongoing process that thrives on deliberation with colleagues; and (f) support teachers in their professional growth and development, encouraging them to share their experiences with colleagues to

inspire them to pursue such professional development activities.

Structure of the Program and Classroom Transfer

Each teacher intern is assigned to a mentor or group of mentors in an active, investigative laboratory setting. They work a typical 40-hour week within a corporate department or within an academic research setting (depending on the program) and become involved in the research projects of their mentors. The expectations of what the teachers will accomplish within the research setting is determined by the length of the internship, the background of the teacher, and the complexity of the questions being researched and techniques being used. Within the scope of their internships, teachers may be expected to engage in such activities as participating in brainstorming sessions, conducting library research, performing experiments, preparing reports, and making presentations.

The mentors chosen to work with teachers have actively sought involvement in the program. Most mentors consider the internship an excellent opportunity to serve the education community and take part because they are interested in enhancing the education of teachers. With the exception of mentors in the university who receive a modest honorarium, mentors are not paid.

The St. Louis research internships place a strong emphasis on curriculum development as a process leading to increased professional development of teachers. As a group, teacher interns are guided through the curriculum development process by a

science/mathematics educator to discuss curriculum design as well as the internship experience. The teachers meet as a group one afternoon per week. The activities they develop must be student-centered, hands-on, and challenging. The learning cycle strategy, a problem-solving approach, or an inquiry approach must be used as the basis for the development of the activities. Some programs stress that the concept of technology and its interrelationships with society should be an integral part of the lesson. The teachers each develop their own lesson(s) because each is engaged in a different content area. However, they work collaboratively to critique one another's materials, pilot one another's activities, and share references and resources. The focuses of the projects are extremely varied and have included such topics as aerospace technology, antigen-antibody interactions, fiber optics, statistical analysis, artificial intelligence, and materials design.

A requirement of the internships is a commitment by each teacher's school district to provide an opportunity for the teacher to conduct an inservice workshop on the internship experience and curriculum development project. The McDonnell Douglas Foundation provides travel stipends for teachers to present their work at local, regional, and national professional meetings. They also present their work at an annual meeting at McDonnell Douglas Corporate International Headquarters. The American Association of Immunologists (AAI) provides funding for teacher interns to attend the annual meeting of the AAI. They not

only attend immunology sessions but present a workshop at the meeting for local teachers. For many teacher interns, these presentations are their first at a regional or national conference.

Teachers can receive graduate credit for participation in any of the internship programs from the University of Missouri-St. Louis.

Outcomes

Teachers perceive that they (a) increased their content knowledge in science and technology, (b) received a somewhat substantial amount of experience in scientific research design and experimentation, (c) increased their understanding of what engineers and scientists do day-to-day, (d) made substantial gains in their knowledge of applications of science in the workplace, (e) increased their awareness of the relationship of math and science to technology and society, (f) renewed their excitement about teaching, and (g) enhanced their desire and ability to design and implement hands-on inquiry-oriented lessons in their classrooms. In addition, teachers report an increase in their feelings of self-confidence, self-esteem, and professionalism. Many teachers more aggressively seek further professional development opportunities and participation in other internship programs. Their experiences reaffirm their reasons for entering the teaching profession and they see themselves as "change agents" in their respective schools and districts.

University of Washington

Ford Fellows Science/Mathematics Project

Type of Program and Grade Levels Served

The Ford Fellows Science/Mathematics Project is a research/project internship. Some of the teacher/interns are engaged directly in research, especially those teachers working in biotechnology firms. Other teachers work on various projects that the employer assigns to them; a project focus is most likely to occur in a city, state, or federal service agency such as the Environmental Protection Agency. The purpose of the work experience portion of the Ford Fellows Science/Mathematics Project is to make the Fellows' classroom instruction more relevant to the needs of business/industry, to introduce the Fellows to new technologies, and to give them actual working (as opposed to shadowing) experiences in the corporate community.

The Fellows are secondary (middle, junior high, high school) teachers of science and/or mathematics. Ten teachers participate each year.

History

The Ford Motor Company Fund gave the University of Washington (UW) College of Education a $500,000 seed grant in 1988 to develop a new kind of masters degree program that would focus on teacher leadership and incorporate a business experience. An additional $70,000 was given by the Fund for

transition year funding. During this current transition year, we are seeking new sponsors for the Project, which will be renamed the University of Washington Science/Mathematics Project. Henceforth, the Fellows in the Project will be named after the individual sponsoring company (e.g. Battelle Fellow). The College of Education is committed to the Project and is assuming all the administrative costs of the Project. This will cut program expenses in half.

There are three university faculty involved in the administration of the Project. The Project Director, Dr. Roger Olstad, is the advisor for students pursuing the Masters of Education degree with an emphasis in science. Dr. Jack Beal, the Associate Director, is the advisor for students pursuing the Masters of Education degree with an emphasis in mathematics. Dr. Carole Kubota is the Director of Programs for the Project and is responsible for recruitment of Fellows, mentors, and business sponsors, and administration of the institutes, seminars, and the Programs in general.

Goals

The goals of the Ford Fellows Science/Mathematics Project are to: (a) prepare science and mathematics teacher leaders who can work as change agents in the systemic restructuring of schools; (b) test and evaluate the efficacy of using experienced science and mathematics teachers as mentors in preparing teaching leaders; (c) test and evaluate the efficacy of summer internships

in industry or public agencies in the continuing education of new teachers; and (d) create and test a model program that can be replicated elsewhere.

Structure of the Program and Classroom Transfer

The Ford Fellows Science/Mathematics Project is a two-year graduate program leading to a Master of Education degree in either science or mathematics education. The Project links industry, public schools, and the UW to integrate work experiences in science and mathematics with academic study and leadership preparation. Fellows are at the beginning of their teaching careers and, when recruited into the program, cannot have taught for more than two years.

During the Project, the Fellows participate in (a) special institutes and seminars focusing on leadership issues, (b) a Masters degree program of study including advanced study in mathematics or science, (c) a collegial team with an experienced science or mathematics teacher leader, and (d) a summer internship program, working in a business or industry related to what they teach.

The responsibilities of the partners involved in the Project are as follows. The Ford Motor Company Fund pays the tuition and fees for the Ford Fellows, provides honoraria for the collegial teammate, and pays salaries and benefits for the Project staff. The corporate community employs the Fellows for 6-8 weeks at $500 per week for one of the summers the Fellow is in the program. The

school districts provide the collegial team (the Fellow and the experienced teacher leader) with $2000 in release time and/or pay for noncontract days so that the team can engage in professional growth opportunities. The University of Washington provides the leadership institutes and special seminars, matches Fellow with collegial teammates, places the Fellows in appropriate businesses, oversees the work experience, and administers and publicizes the program. Beginning next year, the University of Washington will assume all administrative salaries and benefits.

Since the Fellows are teaching full-time while they are in the Project, it generally takes three summers and two academic years for them to complete their Masters' degrees. During the second summer the Fellows are engaged in the business experience.

Fellows develop a "curriculum piece," that they use to share the work experience with their students and colleagues. The pieces varied and include such topics as career information, new laboratory procedures, real-life problem solving, and new teaching methods that incorporate authentic teamwork strategies. The curriculum pieces are developed as part of a required three credit curriculum and instruction seminar, taught by the Director of programs who is a university-based science educator. This seminar can only be taken by the Fellows and is part of their Masters degree course of study.

Another important part of the Project is the leadership institutes and seminars. The development of a cohesive support group of teachers has been crucial to the success of the program.

The process of developing this support group begins with a three-day Fellow/Team Colleague Leadership Development Institute held in the fall of each cohort's first year of involvement. The institute provides an opportunity for the teams to: (a) develop an action plan, (b) develop a common vision of what it means to be a "teacher leader," and (c) gain a better understanding of the goals of the Project.

The action plans produced by each team are flexible, individualized plans that broadly describe what that team hopes to accomplish during the two-year program. These plans include goals in the areas of curriculum and instruction, team building, and teacher leadership. Since the school districts are committed to providing $2000 to each team during the two years the team is together, the team has approximately ten days a year to work on activities described in its action plan. These activities include teaching in each other's classrooms, visiting other schools, and attending professional meetings. Quarterly follow-up meetings during the academic year allow the teams to share their progress on the action plans and keep the teams in contact.

Outcomes

The major goal of the Program is the development of teacher leaders who can work with the systemic reforms occurring in Washington state. We recruit beginning teachers with high potential for teacher leadership, give them a corporate work experience, prepare them as teacher leaders, team them with high-

powered colleagues, and provide them with release time for professional growth. Our Fellows have won both state and community awards for outstanding teaching, designed and implemented district programs for bringing together middle schools and high schools, become involved as presenters in professional organizations, and are called upon to sit on advisory committees. Because of our selection criteria and support given to the Fellows, we feel that most of the Fellows will change agents within the teaching profession.

The corporate work experience is only one strand, but an important one, in our Project's total Master's degree program. The experience has given all our Fellows an extraordinary degree of self-confidence, which is especially important for beginning teachers. Most of the Fellows have a wonderful time "in the other world." They are amazed that they can make a phone call when they want to, go to the bathroom when they need to, and eat a real lunch. They are impressed that they are treated like professionals and have no one looking over their shoulders. But the work experience has also reaffirmed their desire to teach. They miss their students. They can hardly wait to get back to their classrooms to share what happened during their business summer.

Most of the highly successful corporate experiences include a teamwork aspect; Fellows bring these new understandings of teamwork and problem solving back to their classrooms. They incorporate new teaching strategies, engaging their students in

authentic teamwork that is more than just working in pairs on the same laboratory experiment. Students engage in team problem solving, with different teams working on various aspects of a problem.

The use of the computer in the workplace has really impressed the Fellows. Almost universally they plan to incorporate more computer work into their classes. Likewise, they also realize the need to include more student writing and oral communication in their classes. The Fellows view these realizations as an important outcome of their business experiences.

We are currently evaluating the model using both entrance and exit interviews as well as survey questionnaires. Additionally we plan to gather information from the Fellows' principals, the Ford mentors, and the students of the Fellows. Besides the qualitative data we already have, next year we plan to concentrate on collecting quantitative information that will compare the Ford Fellows to other Master's students not in the Program. We also plan to follow the Ford Fellows for a number of years to see if they will be facilitators of change within their systems.

We see this Project as being a win-win proposition for all involved. Businesses invest a little with the payoff being teachers who more fully understand the needs of the industry workplace. School districts invest a little with the payoff being enthusiastic, committed teachers who know how to collaborate in a

highly productive manner. The teachers' "payoff" is not only a Master's degree but the knowledge that even though they could "make it" in the corporate world, they really want to teach.

Industry Initiatives for Math and Science Education

Type of Program and Grade Levels Served

The Industry Initiatives for Math and Science Education (IISME) Teacher Fellows pursue both research and projects at industry sites and government laboratories in the San Francisco Bay area. For example, last summer at ICI Americas (a chemical company) a chemistry teacher synthesized a new herbicide formulation. Meanwhile a math teacher worked at Kaiser Permanente's headquarters designing and training staff to use a project payment tracking database.

IISME has traditionally served high school teachers but has reached out to middle and elementary school teachers in the past few years. Presently, IISME offers summer fellowships to 75-100 teachers a summer. Of these teachers, approximately 75% are high school teachers and 25% are middle and elementary school teachers.

History and Goals

IISME was founded in 1985 by a group of industry engineers and managers who wanted to help improve math and science education, and encourage more students to consider technical

careers. These industry representatives approached the late Marjorie Gardner at the Lawrence Hall of Science and together with Glenn Seaborg they launched the IISME collaborative.

Since 1985, 57 different industries and government labs have offered 608 IISME fellowships to 15% of all high school and middle school teachers in the Bay area. These teachers have in turn reached over a half million students.

From the start, IISME's founders hoped to help develop a nationwide network of scientific work experience opportunities for teachers. Thanks to funding form the National Science Foundation (NSF) and the Hearst Foundation, IISME was able to help 24 other sites start similar programs. NSF and the U.S. Department of Energy (DOE) funding has allowed IISME to host a conference and produce a newsletter to link the 85 programs that now exist nationwide. IISME also produced a directory listing all these programs.

IISME has an annual budget of approximately $700,000 a year. Most of the funding comes from 80 corporate sponsors. Companies pay a stipend to each teacher hired and a fee to IISME to support administrative costs and educational services. In addition, IISME has received major grants from NSF, DOE, and private and corporate foundations.

Structure of the Program and Classroom Transfer

IISME is a nonprofit educational foundation. IISME's executive office handles all industry outreach and the process of

matching teacher applicants to available jobs. It places 75-100 teachers per year out of 200+ applicants.

Teachers apply for fellowships in December. From February to May teachers are matched to job descriptions received from mentors at companies or government labs. The mentors decide who they will hire.

The fellowship period is eight weeks, although teachers and mentors occasionally work out other arrangements. All teachers are paid $700 a week.

IISME's education office is located at the Lawrence Hall of Science at UC Berkeley. Education Director Brian Kearney, who is a geneticist by training, works half-time, as does our Education Coordinator.

IISME's education office evaluates teacher applications before they are entered into a database for job matching purposes. This office also plans three summer meetings -- orientation (for teachers and mentors), mid-summer (for teachers to work on plans to transfer the work experience back into the classroom), and end-of-the-summer (for a celebration).

IISME Teacher Fellows commit to undertake an action plan for classroom transfer. The action plan can be a curriculum project, a career awareness activity, or similar projects. IISME provides a framework of ideas (based on what teachers and industry mentors have told us are the most important outcomes) and let the teachers design an action plan that will be exciting and relevant.

Two teachers join the IISME education office each summer. A Peer Advisor travels from site to site and helps troubleshoot problems and link up teachers with similar action plan ideas. (He or she carries around the 600 action plans of former Fellows!) An IISME-NET Fellow helps teachers use IISME-NET, a world-wide telecommunications network for teachers and students that is available year round. (A group of science students from Russia are regular users.) One of the resources available via IISME-NET is a listing of surplus corporate and government equipment and supplies called IISME Links.

All IISME participants become members of the IISME Academy. IISME offers approximately six academy workshops each year. These workshops are free and are usually held after the close of the school day. A goal of the workshops is to provide teachers with access to scientists and technology that would otherwise be unavailable to them. Examples of titles of past academy sessions include: Looking for Chemistry in All the Right Places (at which a teacher shared labs developed as a result of two summers working at Chevron), Math and Science Concepts Used to Manufacture the Bradley Fighting Vehicle, and Practical and Ethical Issues in DNA Profiling (led by forensic scientists).

Outcomes

IISME's education office evaluates the program. Ninety percent of teachers each year report that their teaching has improved as a result of participating in the IISME program. They

report that they emphasize teamwork communication skills, problem-solving, and the real world to a greater degree than they did prior to their internships. In addition, they report that they introduce more technology in the classroom and do more career counselling. All teachers report affective outcomes -- the experience is one that revitalizes them and improves their self-confidence and enthusiasm for teaching.

IISME surveyed all teachers who had participated in the first six years of the program to reveal lasting impacts. Seventy percent of teachers reported that the IISME experience had spurred them to engage in a greater amount of professional development activities than they had prior to the Program and that they had since taken on leadership roles in their schools. Forty percent said that the experience influenced their decision to remain in teaching.

RET-E^3

Type of Program and History

In the late 1980s, spurred by national studies that awakened the nation to the declining quality in science education, Grand Valley State University launched a joint venture between the university, three school districts, and west Michigan businesses and industries to develop a project-oriented work experience program for science and mathematics teachers. Funding came from a National Science Foundation (NSF) grant.

Goals and Grade Levels Served

The program is entitled "Recognize Exemplary Teachers - Expand, Enlist and Extend (RET-E^3). It's aim is to fuel the quest for teaching excellence by developing approaches to science and mathematics teaching and curricula that are geared to the needs of the 21st century workforce. Specifically, the goals of the program are to: (1) expand the knowledge and experience of K-12 science and mathematics teachers; (2) enlist the human, technical, and financial resources of industry scientists in support of education; and (3) extend these partnerships to students and other teachers through the development of classroom activities based on a summer internship experience.

Structure of the Program and Classroom Transfer

The program is university-based. Co-directors are the Dean of Science and Mathematics, the Director of the Coalition for Excellence in Science and Math Education (a partnership organization housed at Grand Valley State university), an industry scientist, and a K-12 liaison (Mary Ann Sheline) through our Science and Math Center.

RET-E^3 was developed as a four phase program beginning in 1989, with a fifth phase added under an NSF follow-up grant in 1991. Our initial plan was to limit participation to secondary teachers, but our industry partners urged us to include elementary teachers. During the first phase in the winter of 1989, 20 exemplary K-12 science and mathematics teachers were

selected and recognized by the media for their outstanding contributions to science and math education.

The following summer, 12 of these teachers completed the second phase of RET-E^3 by participating in an eight to ten week internship in business or industry. Although the first phase (the recognition phase) was a one-time event, the internship has continued. Between 12 and 14 teachers have been placed each summer since then. The program goal this year is 20 placements.

The details of the RET-E^3 internships are worked out between the teacher and industry mentor during the hiring process. Grand Valley State University acts as a broker by soliciting and accepting applications from teachers, finding companies to offer internships, and matching teacher qualifications to industry criteria. Three or four applicants are sent to each company. Hiring is by mutual agreement.

A sample of internship projects includes: (a) researching and compiling information for the General Motors "Targets for Excellence" project at Accutex, an automotive supplier; (b) determining levels of heavy metals present in products and packaging at Amway Corporation; (c) designing a computer program for keeping the chemical inventory for a division of the BASF Corporation; (d) conducting wheel cover functional testing to determine which design variables have the major effects on wheel cover retention for Lacks Industries, another automotive supplier; (e) performing analytical testing at Parke-Davis; and (f) executing software tests and writing test drivers for Smith

Industries, an aerospace company.

The major mission of the interns is to determine which skills, strategies, attitudes, and knowledge are necessary for their students to succeed in the workplace. To understand the outcomes and effects of this program, one must recognize the corporate atmosphere and culture in west Michigan. The industries are heavily automotive-related and, therefore, are influenced greatly by Japanese management styles. Total Quality Management, which relies on strategies such as continuous improvement and customer service, is a component of the industry culture. The west Michigan chemical and furniture industries are proponents of the Total Quality Management philosophy but interpret this philosophy somewhat differently from the automobile manufacturers.

The third phase of the program, Curriculum Impact, reflects the movement toward quality and excellence so important to our industries. When we talk to the teachers about how their experiences should translate to their classrooms, we repeatedly hear that most of the changes won't be in WHAT is taught, but in HOW it is taught.

Five themes emerged that have become the focus of our Curriculum Impact:

1. In the teaching of science and mathematics, relevant topics must be chosen by the teacher. Without contact with technologically-based businesses and industries, teachers (particularly those who have never worked in industry) have a

poor sense of what content is relevant for their students.

2. The science and mathematics that is taught must prepare students for life-long learning. Problem solving skills of students must be developed in the context of the science and mathematics taught in the classroom. The "real-world" context of science and mathematics experienced by the teachers in this program help them incorporate relevant problem-solving techniques into their existing science and mathematics classes.

3. Science and mathematics must be taught in such a way that teamwork is recognized as a means to approach problems or challenges. The experiences of science and mathematics teachers in this program helps them see the need to have their students work together rather than as isolated individuals in their classes.

4. As science and mathematics is taught, teachers need to show their students that communication is an important part of "doing" science and mathematics. Having experienced the world of business and industry, teachers are able to incorporate effective communication strategies in their science and mathematics classrooms.

5. Science and mathematics must be taught in such a way that it motivates students and encourages quality by cultivating continuous improvement and good work habits.

The first group of interns, in consultation with industry mentors and a facilitator spent six weeks in paid consultation developing and writing Teachers In Industry, Science and Math

Activities, a resource manual for classrooms. This manual translates the teachers' experiences into student activities. In succeeding years interns have added to this dynamic resource by participating in a graduate credit course that refires that teachers create additions to the manual.

Teacher-interns share their experiences with colleagues, preservice teachers, and their own communities in the fourth phase of the program. To date, fifteen inservice workshops have taken place in which teachers have shared their experiences. These workshops are held at industry sites so that the audience and the teachers can interact with industry scientists and see science in action through plant visits.

Outcomes

This program continues today as "The Teachers In Industry" program. A follow-up grant has allowed the development of a fifth phase while the internship, curriculum impact, and industry workshops are continued. During the fifth phase, teachers take part in industry training regarding Total Quality Management, and they apply this philosophy to education. Teamwork, problem-solving, communication, and motivational skills are critical components of this philosophy.

Our plan is to make industry training available to teacher/administrator teams. Through discussion and selection, educators will be able to adapt those ideas and strategies that make educational sense and will serve to improve the quality of

science and mathematics education delivered to students.

We work in this program with a win-win-win attitude.

1. Teachers win because they have a wonderful broadening and enlightening experience that renews their enthusiasm for teaching and gives them an understanding of their discipline in action.
2. Industry wins because much needed projects get done at relatively low costs and they can look forward to a better prepared workforce.
3. Students win because science programs are being infused with quality strategies that will make them better prepared for the world they face. In addition, their enthusiastic and renewed teachers are reviewing the science and mathematics content of their classes and are presenting relevant topics having practical and technological applications.

As one teacher said about the program, "It was a profound experience. It was as if a door was opened and I walked into a very different land. It has changed my entire approach to what I do.